Marion Stone Appeal

Excerpts from the Department's License Record

- Memos and Review Comments from Maine Geological Survey
    - June 28, 2008
    - February 25, 2009
    - September 2, 2009

From Peter Slovinsky MGS June 24, 2008 "Advisory Opinion"

Stone Property, 14 Harmon Street, Scarborough, ME, Permit#L-24089-4H-A-N
Kohlberg Property, 10 Smithers Way, Scarborough, ME Permit#L-24088-4H-A-N

The Stone and Kohlberg properties are located along the southern end of Scarborough Beach, near Prouts Neck. They are separated by a property owned by the Rockefeller family. Both are oceanfront properties that are fronted by a contiguous, timber-construction seawall that stretches along the developed section of Scarborough Beach. The front (oceanside) yards of all the structures along this stretch of beach have maintained the original natural frontal dune vegetation (Figures 1 and 2). The bird's-eye view photographs in Figures 1 and 2 show the oceanfront timber bulkhead, cobble deposits at the base of the seawall, a bulge in the shoreline and seawall that fronts the Stone property, and overwash along the Stone seawall. Note that cobble deposits terminate just north of the Stone property, and that the "dry beach" pinches out just north of the Stone property.

A section of an existing timber bulkhead seawall along the Stone property, at the bulge noted in Figures 1 and 2, was damaged in the 2007 Patriots' Day storm. Damage along the seawall, including a portion of the wall owned by the property owner to the north, was documented by MGS on April 20, 2007 (Figure 3). Although the entire stretch of residential development along this portion of Scarborough Beach was extensively overwashed during the storm, this is the only section of seawall that failed, along with a small adjoining section of a neighboring wall to the north (Rockefeller property). Sediment was released to the beach during the failure in a manner similar to frontal dune erosion in a natural setting. The bulkhead section of the Rockefeller property was repaired under a Permit-By-Rule to pre-existing conditions, dune sand replaced, and dune grass was planted. The section of wall that was damage previously bowed seaward along a portion of its stretch (see Figure 2). The entire seawalled stretch of this section of the beach was extensively overtopped, with overwash deposits penetrating over 150 feet into the dune (Figure 4).

The frontal dune along this stretch of beach is fronted by a contiguous, narrow wooden bulkhead. However, native frontal dune vegetation (i.e., American beach grass) has thrived along the backside of the wall along the entire stretch of seawalled coastline. The footprint of the existing vertical wall is relatively small within the frontal dune. The wall does, however, cause beach scour due to wave reflection. The level of sand that fronts the wall still typically changes on the order of 2-3 feet per season, with sediment being eroded and cobbles exposed during the winter, and sediment returning and cobbles being covered during the summer months. The assumed summer beach elevation (7.5 ft) referenced in the prepared report does correspond with our measured elevations (2.3 m NAVD) using RTK-GPS.

As a result of the seawall failure at the property during the 2007 Patriots' Day Storm, the Stone family proposes to reconstruct the entire length of the bulkhead (238.5 linear feet) with a sloped rock revetment, to replace the temporary rip-rap which was placed (Figure 5). The timber wall fronting the Kohlberg lot is in slight disrepair, with some timber damage and exposure at the base of the existing wall (Figure 6). The Kohlbergs also propose to replace their existing timber bulkhead (163.6 linear feet) with a sloped rock revetment. Both projects are shown on Sheet C-2, with plans for the Stone project shown on Sheet C-3, and the Kohlberg property on Sheet C-4.

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According to submitted plans (C-6), the revetment would reach an elevation of +14.5 ft (assumed reference to NGVD). The V-zone elevation, according to the effective FIRM (included as Attachment 4 in the application materials), seaward of the wall is 15 ft NGVD, while behind the wall, the V-zone BFE is 14 ft NGVD. The revetment elevation is *0.5 feet below the existing V-zone BFE* along this stretch of the Scarborough shoreline, based on the effective FEMA FIRM. We assume that this proposed maximum seawall elevation is the same as the previous wall which was damaged. *We recommend that a dune crest at both locations be constructed landward of any proposed seawall so that the dune crest elevation exceeds the published V-zone BFE.*

The seaward toe of the proposed rip-rap slope extends about 7.5 feet seaward of the "typical line of existing vertical seawall" (Sheet C-6 in both applications). Consequently, the proposed project would extend farther seaward than the wooden bulkhead seawall and thus take up space on the beach. In our opinion, this incursion on the beach – seaward of the pre-storm footprint of the former bulkhead seawall - would unreasonably interfere with seasonal beach sediment movement.

At the Stone property, we also recommend that any seawall design, whether it be a sloped wall or vertical structure, effectively *remove the bulge in the shoreline that was present prior to the Patriots' Day storm.* The new wall should begin at a location that ties in with the adjacent shoreline, thereby removing the erosion-prone bulge. This would likely help the natural migration of cobble down the beach and formation of the natural cobble apron adjacent to the seawall. This cobble apron aids in dissipating wave energy before it reaches the seawall.

The proposed project includes the use of granite abutments (Sheet C-5) to transition back to vertical seawalls at the ends of both projects. We are concerned about end-effect erosion that may occur at these abutment locations, as the transition between a vertical feature and a sloped feature (such as the seawall proposed) can lead to focused wave attack. This could lead to a washout of the adjacent dunes, including the Rockefeller property located to the north of the Stone property (Figure 7).

As a whole, we are concerned about the impacts of the *increased horizontal footprint* of a sloped wall at the proposed locations, and are not sure whether or not the decrease in wave reflectivity (no calculations have been provided, but we assume reflectivity of a sloped structure to be less than that of a vertical structure) afforded by the sloped wall would *outweigh* the negative impact of the increased footprint of the seawall. This concern stems from the fact that behind the existing walls, the entire frontal dune is vegetated and effectively traps sand and cobbles with native dune vegetation, not artificially planted vegetation. The existing horizontal footprint of the vertical seawall within the frontal dune is minimal and on the order of 1 foot.

According to the submitted plans (Sheet C-6), the proposed project at the Stone property would result in the loss of approximately 3,843 SF of frontal dune. This number was attained by combining the area of loss designated as D (behind former seawall to top of new sloped revetment wall), and area A (top of new wall to replanted grass). At the Kohlberg property, the existing frontal dune loss would be approximately 2,365 SF, for a total of 6,208 SF (0.14 Ac.) of frontal dune that is lost as part of the proposed project.

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From a functionality standpoint, we do not expect the two small, sloped walls that would result from the proposed projects to have a large positive impact on the beach seaward of the walls. The proposed projects would result in two small, independent stretches of seawall that would be sloped rip-rap, with the remaining sections of the wall vertical in nature. As a result, it is possible that wave runup and overwash during storm events may actually be worse at these two locations due to wave focusing. This is a detriment to the habitable structures, but possibly would benefit to the natural functionality (i.e., overwash and sediment deposition) of the backside of the frontal dune and the back dune system.

In summary, we are not convinced that the positive impact to the beach (from an unquantified reduction of wave reflection and altered sand budget) from a sloped wall design offsets the negative impact of the increased horizontal footprint and loss of naturally vegetated dune surface within the frontal dune at these locations. The natural dune surface traps sediment and absorbs water from splashover flooding in storms. During catastrophic storms, some of the frontal dune sand and cobbles may be released to the beach if seawalls fail. This transient shift of sand from the dune to the beach mimics what a natural frontal dune would due farther north along Scarborough Beach. The proposed highly engineered structure will most likely prevent any future frontal dune sediment from reaching the beach in a storm.

Because the frontal dune in this area is natural dune vegetation, impacts of the sloped wall design on the existing frontal dune would be greater than if the area landward of the existing seawalls at both properties were developed with impervious surfaces (such as sidewalks and roads) or other development as defined in the Coastal Sand Dune Rules. If many contiguous properties were involved in the project, the potential for reducing reflectivity and improving beach function may be realized, however the sediment exchange between the dune and beach is even less likely to occur in the future. In the cases reviewed here, we do feel that the negative impacts to the frontal dune (physical removal of existing dune and vegetation and replacement with sloped rip-rap walls) outweigh the benefits of a proposed sloped wall construction.

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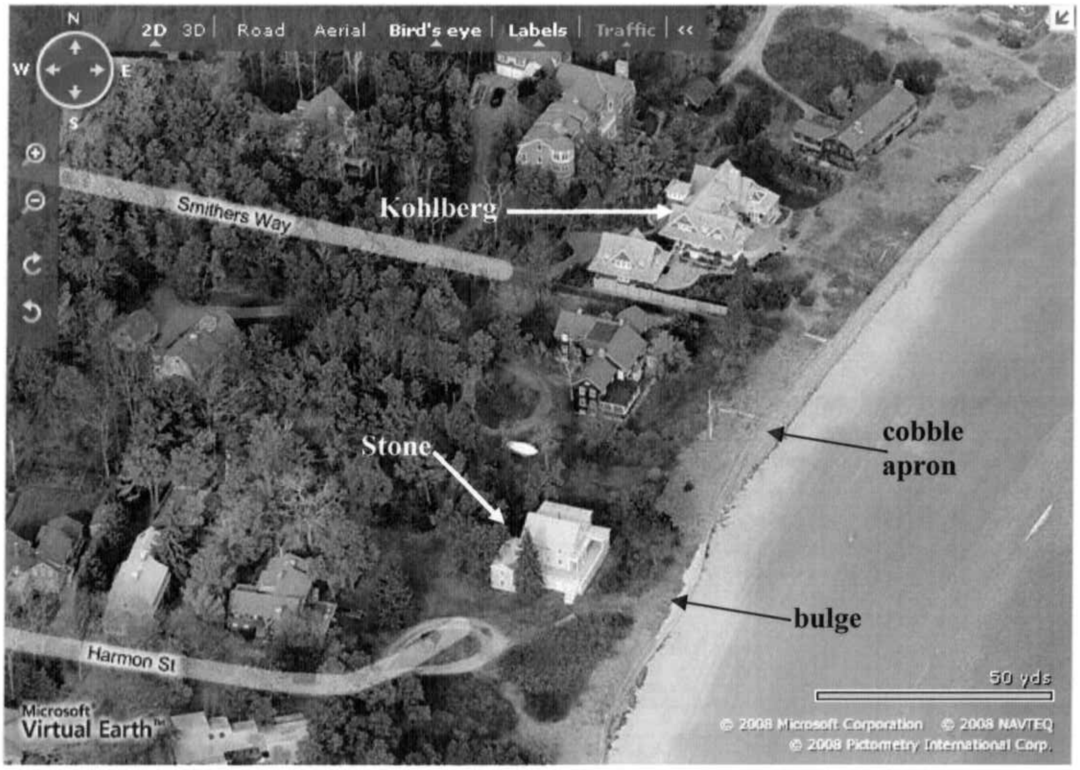
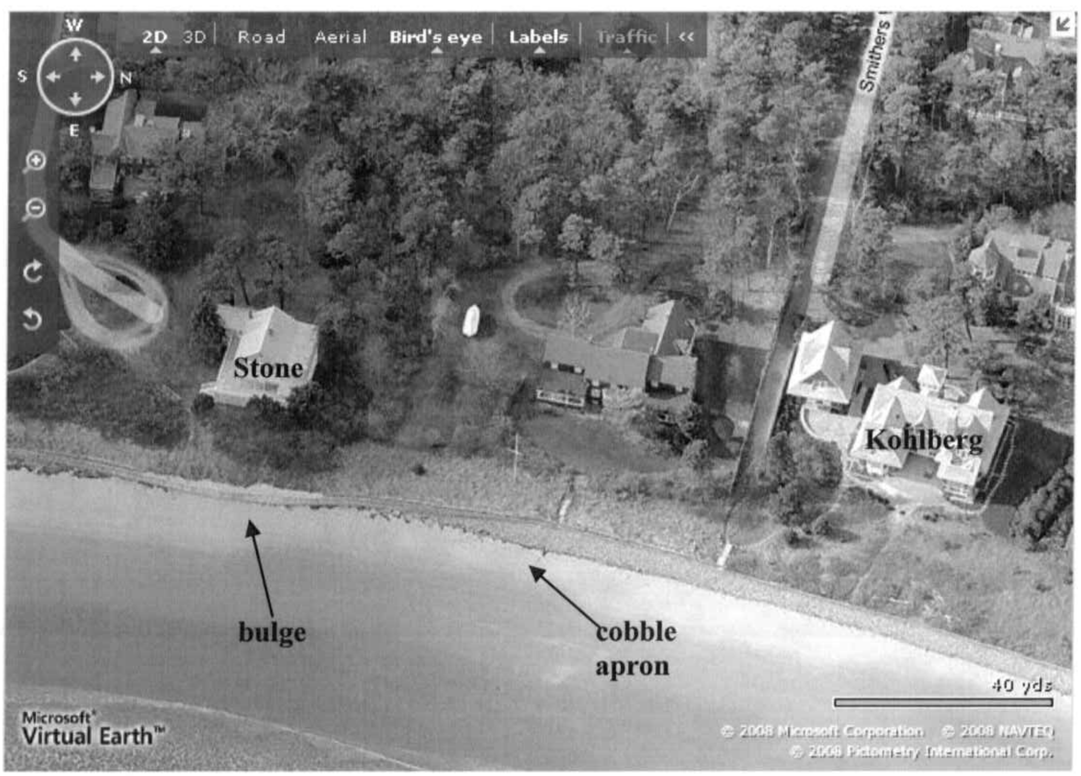


Figure 1. Bird's-eye view of the Stone and Kohlberg properties, looking north. Note the bulge in the shoreline fronting the stone property, with overwash. This is the area that was damaged during the Patriots' Day storm. Also note the cobble apron at the base of the seawall just north of the Stone site.

Figure 2. Bird's-eye view of the properties, looking west. Again, note bulge in shoreline and the prominent cobble deposits. Images from Microsoft Virtual Earth.



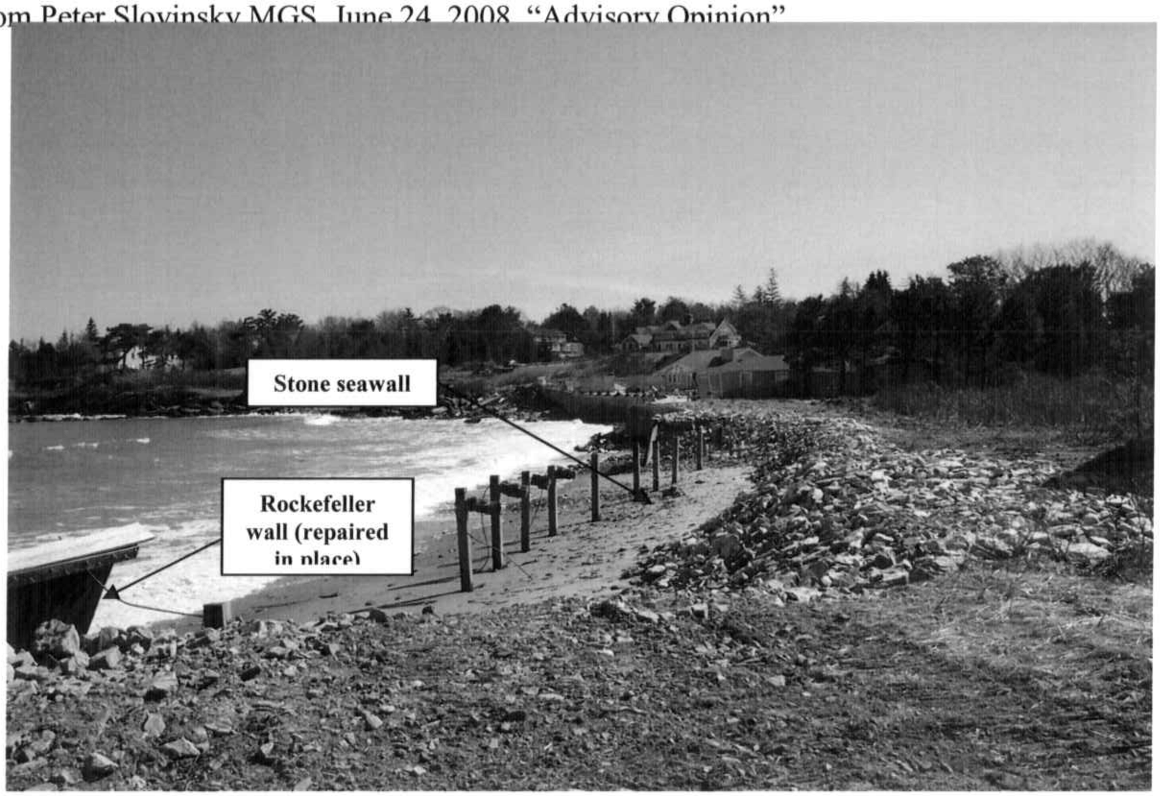


Figure 3. View south of failed seawall along the southern end of the Rockefeller property and the Stone property. Rip-rap was placed as a temporary measure of protection. The timber tie-backs from the pre-storm wall remain. The portion of the Rockefeller wall shown was repaired under a permit-by-rule, and damaged dune grass was replanted. Photograph by P.A. Slovinsky, MGS, April 20, 2007.

Figure 4. View of overwash along the seawalled stretch of the beach, north of the Kohlberg property. Overwash penetrated over 150 feet into the dune. Photograph by P.A. Slovinsky, MGS, April 20, 2007.

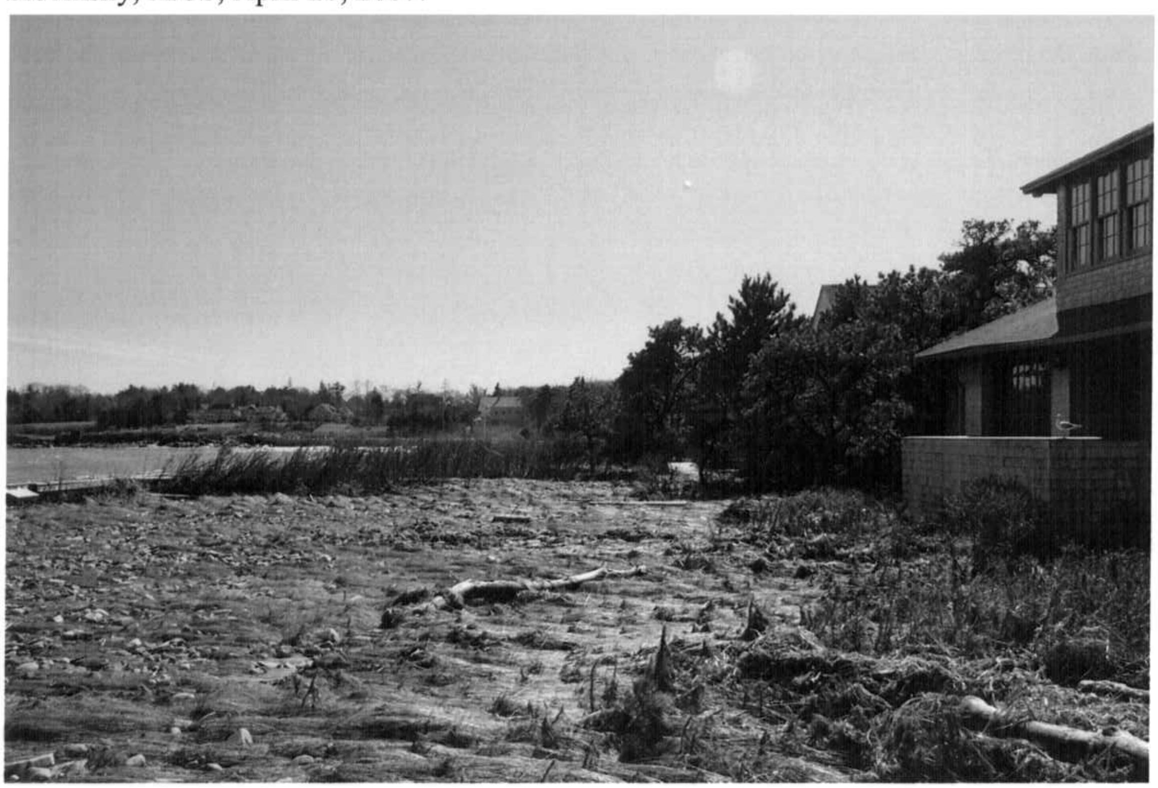


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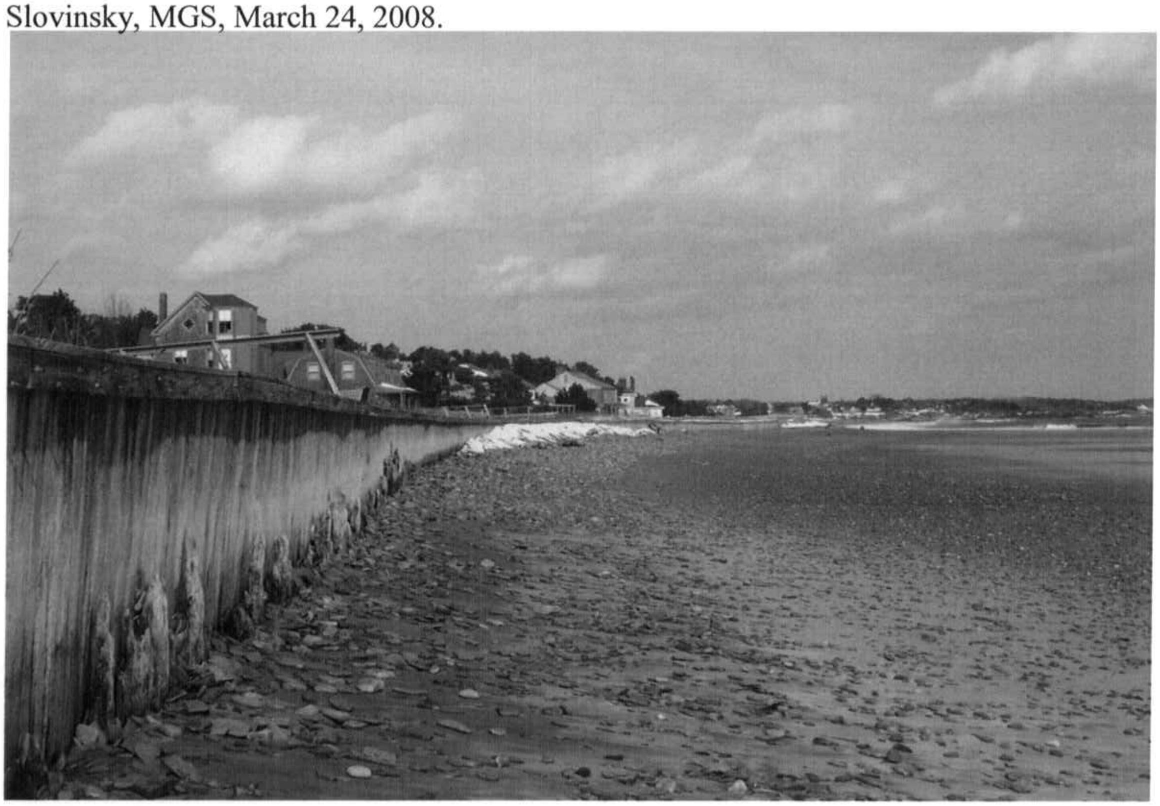
Figure 5. Photograph looking north from the Stone property into the replanted and repaired Rockefeller property. The proposed project would have an abutment (see Sheet C-5 of the submitted plans) at the terminus of the proposed seawall. Photography by P.A.Slovinsky, May, 2008.

Figure 6. View looking north along the Kohlberg seawall. Note minor damage to the base of the wall. This area typically forms a cobble apron during the winter months. Photograph by P.A. Slovinsky, MGS, March 24, 2008.



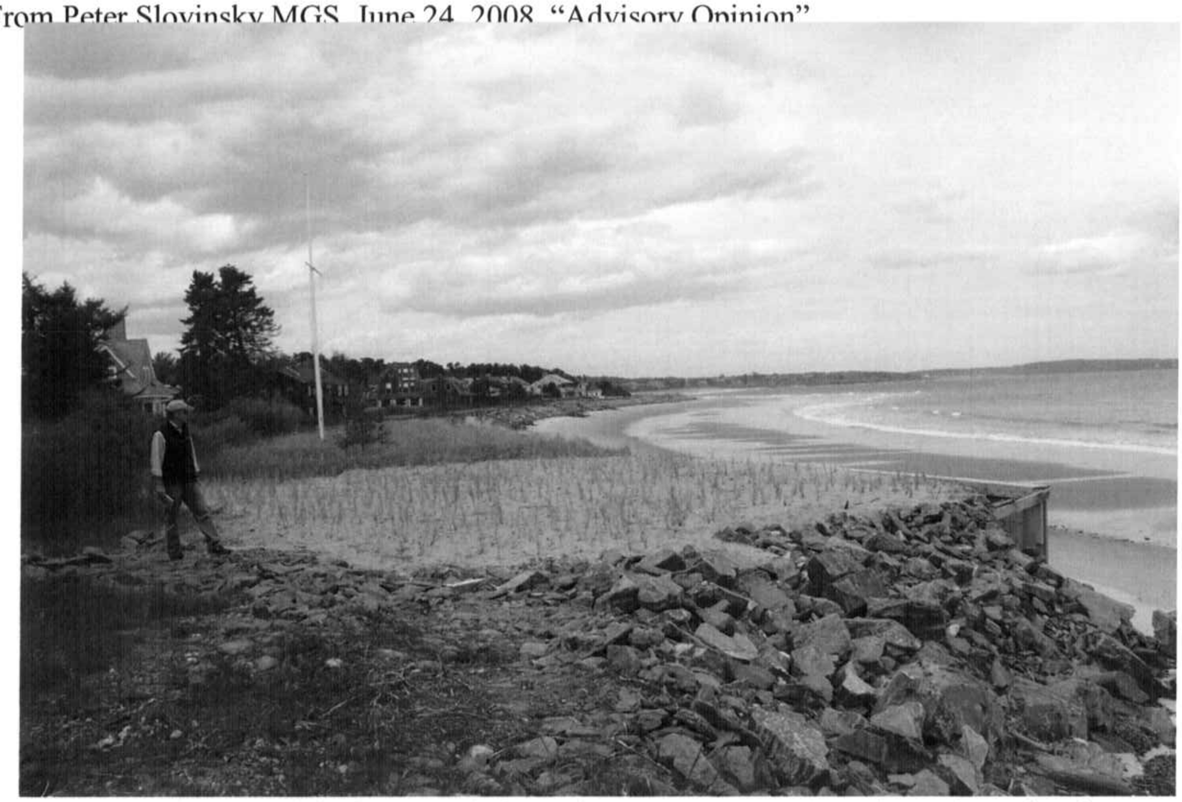


Figure 7. Photograph looking north from the Stone property into the replanted and repaired Rockefeller property. The proposed project would have an abutment (see Sheet C-5 of the submitted plans) at the terminus of the proposed seawall that may exacerbate wave activity at the seawall interfaces. Photography by P.A.Slovinsky, May, 2008.

INTERDEPARTMENTAL MEMORANDUM

MAINE GEOLOGICAL SURVEY, DEPARTMENT OF CONSERVATION
22 STATE HOUSE STATION, AUGUSTA, ME 04333-0022, (207) 287-2801

DATE: 02/25/09

TO: BILL BULLARD, ENVIRONMENTAL SPECIALIST, LAND AND WATER QUALITY

CC: PETER A. SLOVINSKY, COATAL GEOLOGIST, MGS
BARNEY BAKER, BAKER DESIGN CONSULTANTS, YARMOUTH, ME
JAY CLEMENT, US ARMY CORPS OF ENGINEERS, MAINE PROJECT OFFICE

FROM: STEPHEN M. DICKSON, PH.D., STATE MARINE GEOLOGIST

RE: NRPA PROJECT REVIEW OF SUPPLEMENTAL TECHNICAL MEMO FROM WOODS HOLE GROUP FOR L-24089-4H-A-N, STONE AND L-24088-4-H-A-N KOHLBERG SEAWALL REPLACEMENT AND MODIFICATION, SCARBOROUGH BEACH, SCARBOROUGH, MAINE

After a thorough review of the above project, as presented to us, and consideration of our agency's standards, programs and responsibilities, the following supplemental comments are submitted to the Department of Environmental Protection.

These comments supplement our earlier memo from Peter Slovinsky June 24, 2008 for the above cited applications that propose to replace a vertical wooden bulkhead wall. Baker Design Consultants submitted a November 7, 2008 Technical Memorandum from the Woods Hole Group consulting firm on November 18, 2008 for our consideration. The analysis applied coastal engineering equations to contrast the effect of two alternatives – a replacement vertical bulkhead and a sloped revetment – on coastal flooding, wave reflection, toe scour, and beach and dune sand budgets. We call your attention to the fact that neither design is a replacement in-kind but rather both include significant additional engineering works landward of the previous structure and in the frontal dune geologic environment.

Coastal Sand Dune Rules. Decisions about the alternatives must be weighed in relation to the Coastal Sand Dune Rules (Ch. 355) which are vague about the relative merits of benefits that are short-term (say measured in years) and long-term (say decades to a century from now). The WHG memo suggests that the long-term benefits to the coastal sand budget favor a revetment while the short-term impacts are less for the bulkhead (vertical seawall). Generally speaking, MGS favors emphasis on the long-term impacts if the structural modification is better for the *entire* Coastal Sand Dune System, including adjacent beaches and dunes.

The Department of Environmental Protection will need to decide (a) if one of the proposed engineering approaches is better than replacement of an in-kind structure and

(b) if either of the proposed alternatives is an expansion of development or an enlargement of a seawall:

1. Must short-term AND long-term impacts to the sand budget of the dune must both be positive (which they are not without mitigation)?

2. Can short-term negative impacts be outweighed by potentially positive long-term impacts?

3. Is significant "development" of up to 0.14 acres of engineered rock works in frontal dune consistent with (a) development restrictions and (b) the seawall prohibition in the Coastal Sand Dune Rules?

To help with these decisions we provide some additional background information and comments below.

Tide and Storm Levels. We provide our own determinations of tidal stations established by the National Ocean Service at Portland Head and Old Orchard Beach and compare them to Portland Harbor in the table below. Despite slight differences, we do not expect using our values would make a significant difference in the outcome of the WHG analysis. It appears that the outer coast locations have slightly lower high water elevations than Portland Harbor so the WHG use of 9.55 ft NGVD for a 100-year return period storm matches that of the February 1978 Blizzard, often considered a 100-year storm event.

Water Level (NGVD 29)	Table 1 (WHG, 2008)	Portland Head Light (MGS, 2009)	Old Orchard Beach (MGS, 2009)	Portland Harbor NOS Tide Station
MLLW	-4.57	-4.39	-4.31	-4.51
MLW	-4.17	-4.06	-4.01	-4.17
MHW	4.78	4.84	4.79	4.95
MHHW	5.42	5.22	5.30	5.39
HAT* (7/24/09)		6.86	6.94	7.09
Feb. 1978 Storm, Portland Harbor				9.61

* HAT is Highest Annual Tide for calendar year 2009 in Portland, Maine.

Engineering Calculations. MGS is not in a position to critically review the engineering equations applied in the calculations. We are not certain if the published literature contains other formulas that would show different results or not. Nor are we certain of how sensitive some of the calculations are to the constants or parameters used – for example in determining the volumetric rates of overtopping in each alternative. DEP may want to have an independent review or assessment from a coastal engineer to offer guidance here.

Sediment Budget. We favor the use of a sediment (sand) budget to estimate impacts of the alternatives on the coastal sand dune system. The sediment budget is estimated by WHG using a proportionality constant from the reflection coefficients of each structure.

Their calculations show that the revetment has a 35% lower reflection coefficient than the vertical bulkhead, so the sediment budget on the beach results in less sand loss over time.

As the WHG memo indicates, there is no simple empirical method for this determination so they estimated the depth of toe scour from the reflection coefficient (Table 6) and then used that erosion to calculate sand volume loss (Table 7). The approach is based on individual storms so the sand budget is for effects that last for a period of hours. The WHG memo indicates that the proposed revetment could have a positive effect on the sand budget of the beach - realize that this is only for storm conditions. According to submitted plans, in terms of frontal dune surface area impacted by the project, there is a long-term sand loss of 3,843 SF (Stone) and 2,365 SF (Kohlberg), for a total dune loss of 6,208 SF (0.14 acres). Sand excavated from the frontal dunes at both sites would be 300 cubic yards for the bulkhead or 2,340 cubic yards for the revetments (WHG's Table 7) which *could be conserved* on site. *Note that the revetment footprint would cause a short-term adverse impact that is eight times greater on the frontal dune.*

Storm Flooding. Coastal flooding and washover (sand transport landward of the seawall) is to be expected in the frontal dune at this site. According to MGS measurements from aerial photographs, the 1991 Halloween Storm transported sand up to about 100 feet landward in this area. Field measurements by MGS after the 2007 Patriots' Day Storm showed that washover extended inland about 130 ft at the Stone property, and over 150 ft at the Kohlberg property. Mr. Pratt's letter to you on March 28, 2008 also indicated storms resulted in flooding over 100 feet from his bulkhead (abutting the Kohlberg lot on the north). Overtopping during storms is likely to lead to onshore sand transport over the top of both structures. WHG addresses overtopping by providing wave runup and overtopping calculation results in Table 3 of its report. Their report shows that the amount of overtopping is greater for the bulkhead alternative (p. 12). Dune and seawall overtopping is a process required for the natural transfer of sediment from the beach into the dune system, though it understandably needs to be balanced in order to limit damage to structures behind the bulkhead or revetment.

Wave Dynamics at Wall Ends. The WHG report identifies significant wave impact and runup at the ends of the sloped revetment seawall design. The Goda equation, used by WHG, models increased wave heights (*as much as 8 times perhaps*; WHG memo p. 20) that might result in more splashover into the dunes. The report suggests "…significant energy increase would occur near these abutment regions and could result in increased runup and overtopping…" (WHG memo p. 20). *This overtopping may result in significantly increased flooding of abutting property.* This impact may be contrary to the Natural Resources Protection Act, M.R.S.A. Title 38 Section 480-D(6) that requires that "[t]he activity will not unreasonably cause or increase the flooding of the alteration area or adjacent properties." Furthermore, we are concerned that increased flooding could cause hydrostatic loading behind an abutting seawall and likely increase seaward-directed forces imparted to a neighboring seawall from the flooded frontal dune. The engineering strength of the adjacent seawalls is unknown; however, simulations in the WHG report suggest even a new engineered vertical seawall or revetment design proposed may be subject to failure in large storms. So our concern is that the added flooding of a neighboring property could result in an increased risk of seawall failure on abutting properties compared to the pre-existing condition or replacement of an in-kind seawall.

Seaward Extent of the Revetment. *The seaward toe of the proposed alternatives should not extend seaward of the footprint of the previous seawall.* We commented on this in our earlier memo. It is our understanding of the Coastal Sand Dune Rules that engineering structures cannot extend farther onto the beach (even if seasonally buried) than a pre-existing structure. This condition was required of the Town of Scarborough for the Higgins Beach seawall replacement (L-23975-4H-A-N). To build a stone structure out onto the beach would add additional engineering on a natural beach, remove some sand volume from active exchange on the beach profile through burial, and limit alongshore public access during higher tides. However, locating the toe of a revetment landward from that in the designs will result in greater vertical offsets with adjacent walls and potentially greater wave action and flooding directed at abutting properties than that evaluated in the WHG technical memorandum.

Mitigation with Sand. Short-term impacts to the sand budget are proposed by the WHG to be mitigated with retention of sand excavated for each alternative with the possible addition of imported sand to be place on the dune. *We agree that **if an alternative is constructed**, this should be a **required** condition of the permit.*

Stone Mattress on Dunes. We are still concerned about the use of the stone mattress that is included in both proposed bulkhead and revetment design alternatives. The stone mattress increases the footprint of the structure (albeit "buried" by sediment), and further traps available dune sediment within the engineered structure. It seems that a large percentage of the naturally-vegetated frontal dune becomes "developed" with the construction of the stone mattress in each alternative. We wonder about available design alternatives that could remove the mattress and use tiebacks only, thus minimizing additional footprint impacts (which are not included in the existing footprint calculations) on the coastal sand dune system.

Bullard, Bill

From: Dickson, Stephen M.

Sent: Wednesday, September 02, 2009 1:31 PM

To: Bullard, Bill

Cc: Slovinsky, Peter A; Barney Baker

Subject: MGS Comments on Stone (L-24089-4H-A-N) and Kohlberg (L-24088-4-H-A-N) Seawall Modifications, Scarborough

Bill,

We have a few final thoughts for you to consider in your review of these applications.

1. Energy Reflection vs. Wave Overtopping. We reviewed Supplement 7 and considered the issue of the 0 to 50% energy increase (Supplement 6, p. 2 under *Transition with adjacent properties*). The explanation (Supplement 7 p. 2) is confusing, unclear, and not supported by new facts. It seems from comments in Supplement 7 that the point of mentioning that "increase" (in Supplement 6) was in comparison to the proposed sloped revetment. Supplement 7 says:

> "...the net energy impact of the transition wall 'will be within a range of 0 to 0.5 times increase' over that of a sloped revetment."

Perhaps this is the basis for the statement: the sloped revetment has a reflection coefficient of 0.56 to 0.58 so a 0.5 times increase might be 1.5 x 0.58 = 0.87. This is less than or about the same as the vertical wall reflection coefficient of 0.90. While this is similar in magnitude to the pre-existing condition it still **relates to wave reflection back onto the beach** in a storm.

As we see it, the value was originally established to describe wave energy reflection perpendicular to the shoreline and not the complex side reflection and interaction of waves at the ends of the structure. In fact, one might argue that with less reflection there is more wave energy (and hence water) propagating in a shoreward direction. It seems possible that this condition could potentially result in **more water overtopping the riprap or the curved seawall**.

We know from the first technical analysis by the Woods Hole Group that both the existing bulkhead and proposed riprap structures get overtopped in large storms. The response (Supplement 7, p. 5) is:

> "The curved timber solution offers a gradual transition between the sloped revetment and the vertical bulkhead *to maintain any impact entirely on the applicants' property*" (emphasis added.)

It is unclear to us how this claim of localizing the impact to the applicants' property can be supported. We understand that there is more distance from the curved wall to the property lines but, as we have mentioned previously, overwash extends well into all of the lots. It is not clear why the splash over that was once evenly perpendicular to the shoreline will not become more concentrated in the direction of abutting lots with a curved wall. I recently spent some time observing wave refraction, runup, reflection, and interaction patterns from Hurricane Bill on sloped shorelines and curved seawalls and saw some very complex and forceful overtopping that I believe would be extremely difficult to model with certainty. Questions that are still (and may remain) outstanding, even with the curved design: **(a) are there increased flood hazards, (b) is wave overtopping more focused, and (c) is there more dune scour on abutting properties?**

The orientation of the curved wall suggests to us that the direction of wave reflection would no longer be straight offshore but rather redirected at an angle to the beach. The consequences of this altered runup and backwash are unclear but might include water flowing back to the beach between surges in concentrated areas – conceptually creating a rip current-type of flow across the sandy beach. If this were to happen, we are concerned that **the beach might be preferentially eroded in front of the revetment**.

2. Loss of Frontal Dune. If you consider the frontal dune landward of the former or existing wooden seawalls part of the "resource" then the sloped riprap covers a relatively significant area of this pre-existing resource. The surface **area of sandy, vegetated frontal dune is reduced** even if some of the dune sand is redistributed on remaining dune surfaces.

In other locations where this type of replacement seawall construction has occurred (e.g. Higgins Beach in Scarborough) the new project's footprint was essentially over a pre-existing engineered footprint. In Saco along Surf Street the installation of a geotube was on the footprint of the road and not allowed to extend into the resource. This is not the case at these locations on Scarborough Beach. In my opinion the Coastal Sand Dune Rules do not necessarily imply the loss of a frontal dune is an acceptable "sacrifice" but rather that a seawall redesign may move landward into areas of existing development where the "resource" has been altered prior to the Rules coming into existence. **It is precedent-setting to remove some of the frontal dune surface and replace it with coastal engineering**.

3. Buried Engineering. On the design that replaces the vertical wall with another one that includes sheet pile, note that there is geotextile fabric behind the wall that encases some of the sand. While not exactly an enclosed geotube, dune sand is partially enclosed and this design also represents the **installation of subsurface engineering in the frontal dune** – again beyond the footprint of the pre-existing structure.

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